Progress report : Non-linear MHD simulations of pellet triggered ELM in JT-60SA

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and thanks to all colleagues

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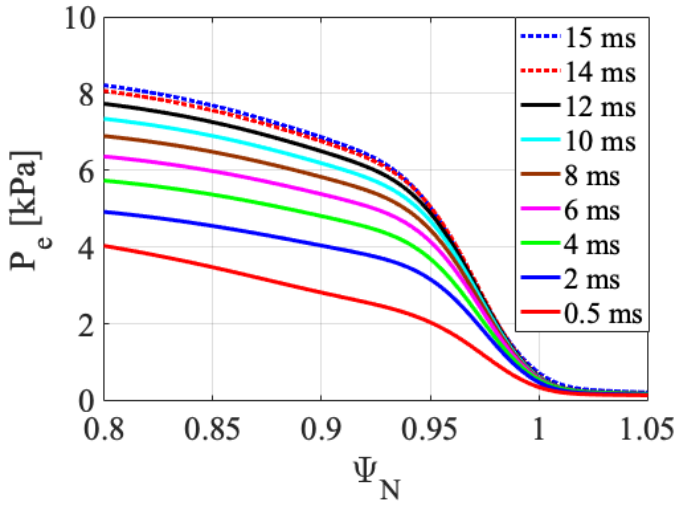
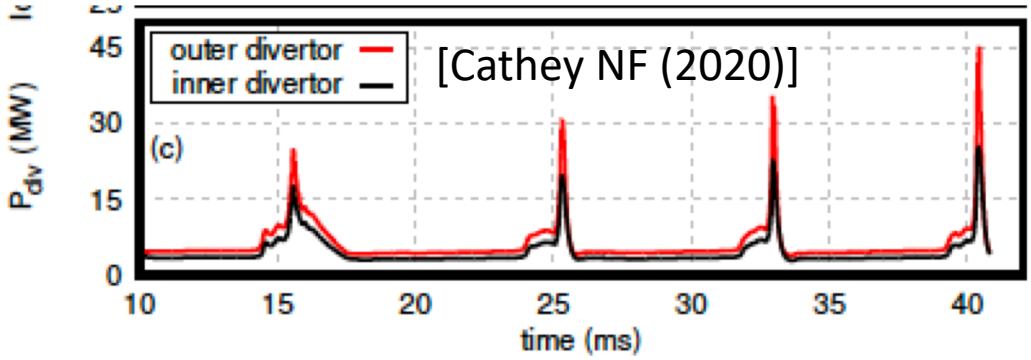
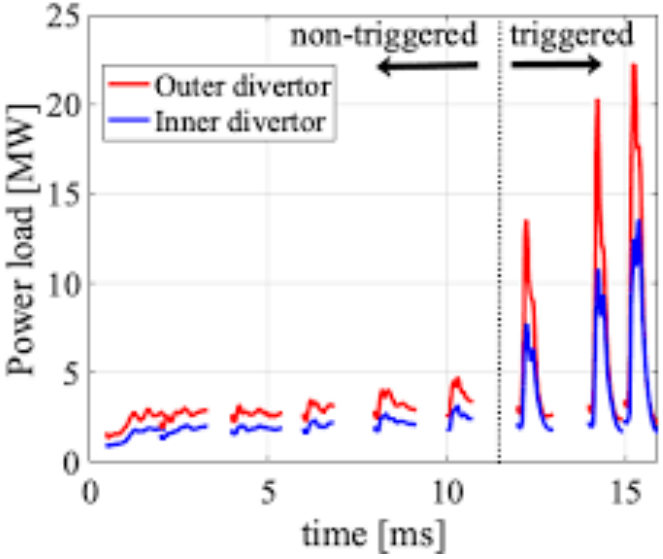
Plan 2022

- Objective : Manage simulations with realistic plasma flow (diamagnetic term, neoclassical term, etc) which can evolves the pedestal profile. [Cathey, Hoelzl, NF 2020]
- Multi-ELMs simulation will be extremely useful for future ELM modelling works.
- The pellets will be injected inter-ELM phase (same approach with [Futatani et al., NF 2021]).

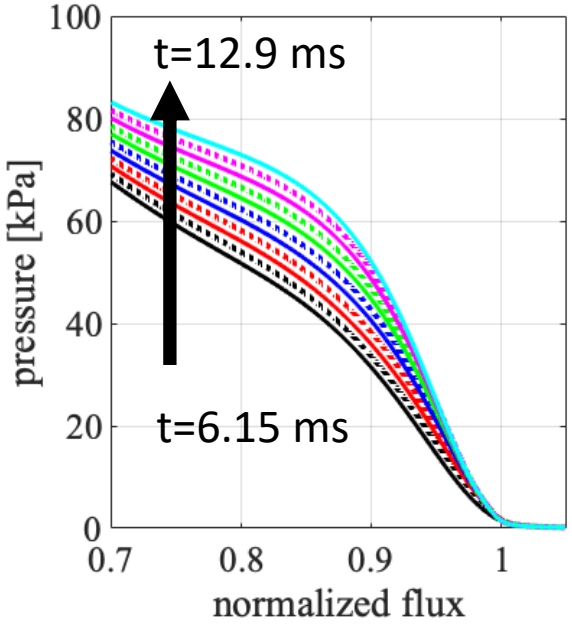


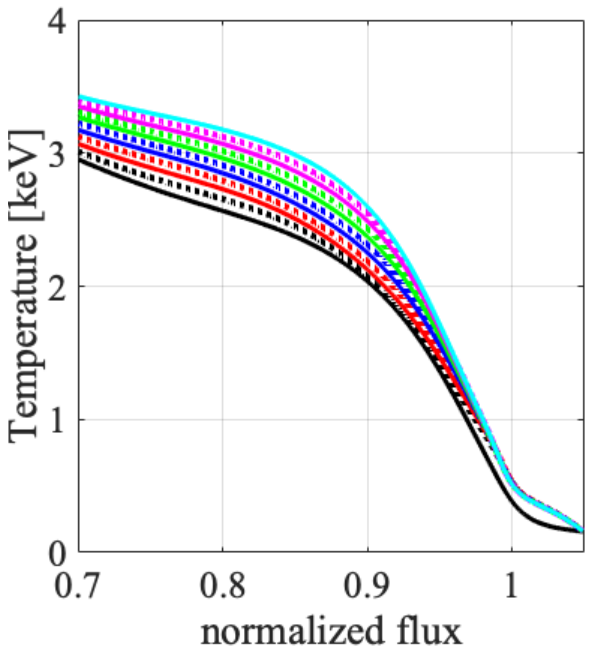


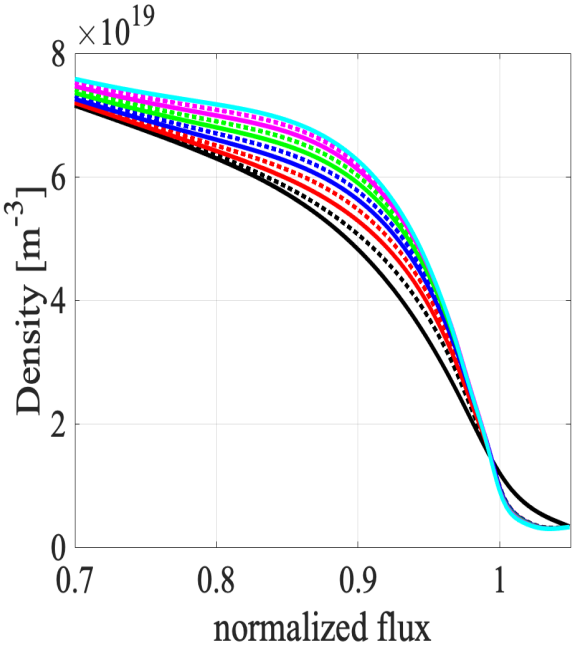


Status 2022 (by May 2022)

- The preparation of simulation set-up for multi-ELM events.
- It requires to find appropriate parameters (particle/heat source etc.) which reproduce reasonable build-up of pedestal profile.



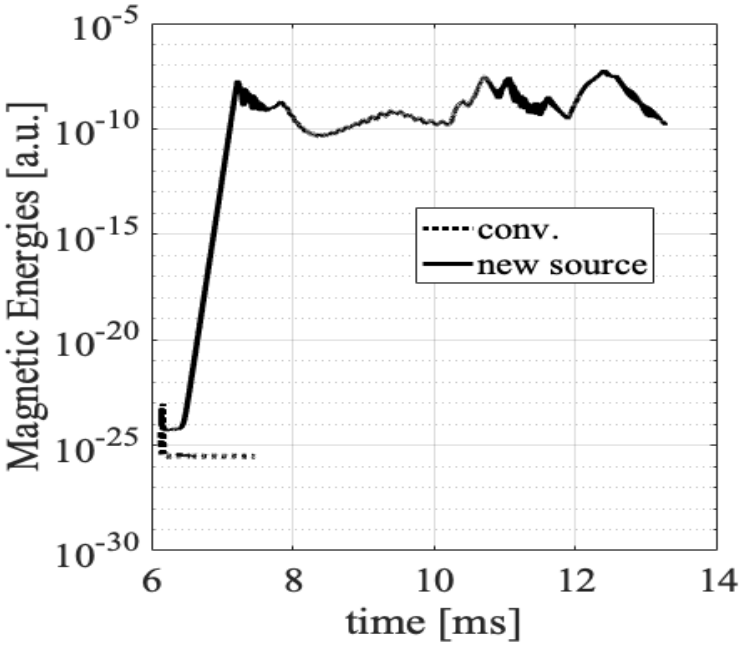


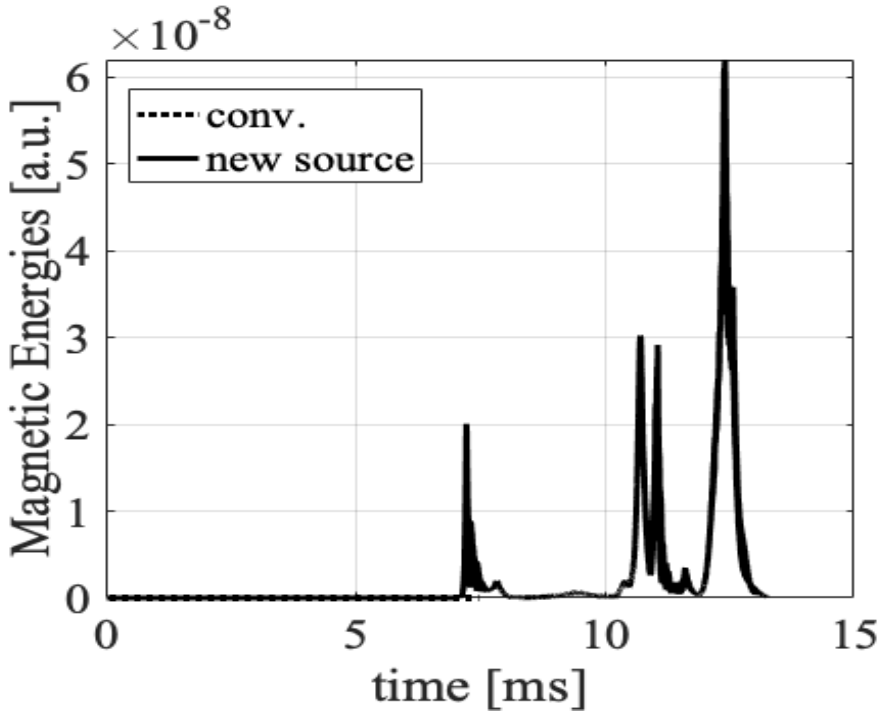


At the time of May 2022, the evolution of the pedestal can be reproduced using simulation of n=0 mode (without toroidal harmonics).

Status 2022 (up to now)

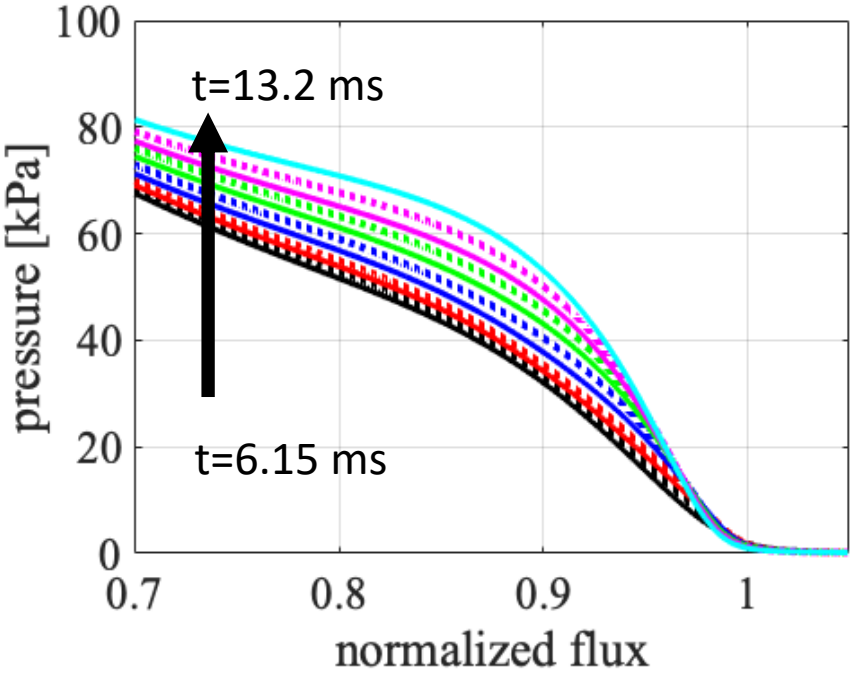
- Simulations of n=0 and n=8 toroidal modes are performed.
- The plasma equilibrium is stable, i.e. without modification of source, it is always stable.
- The increase of particle/heat source increases the toroidal n=8 mode.
- The n=8 mode shows some spikes, but they are not ELM…
  - The amplitude is too small, ~10^{-8}.
  - No relaxation process in plasma profiles (see next slide)

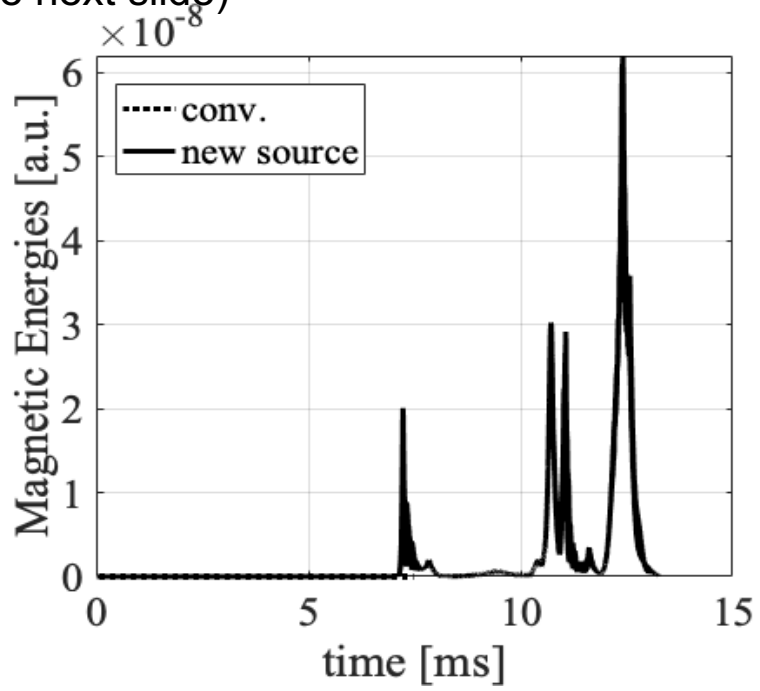




Status 2022 (up to now)

- The n=8 mode shows some spikes, but they are not ELM…
  - The amplitude is too small, ~10^{-8}.
  - No relaxation process in plasma profiles (see next slide)

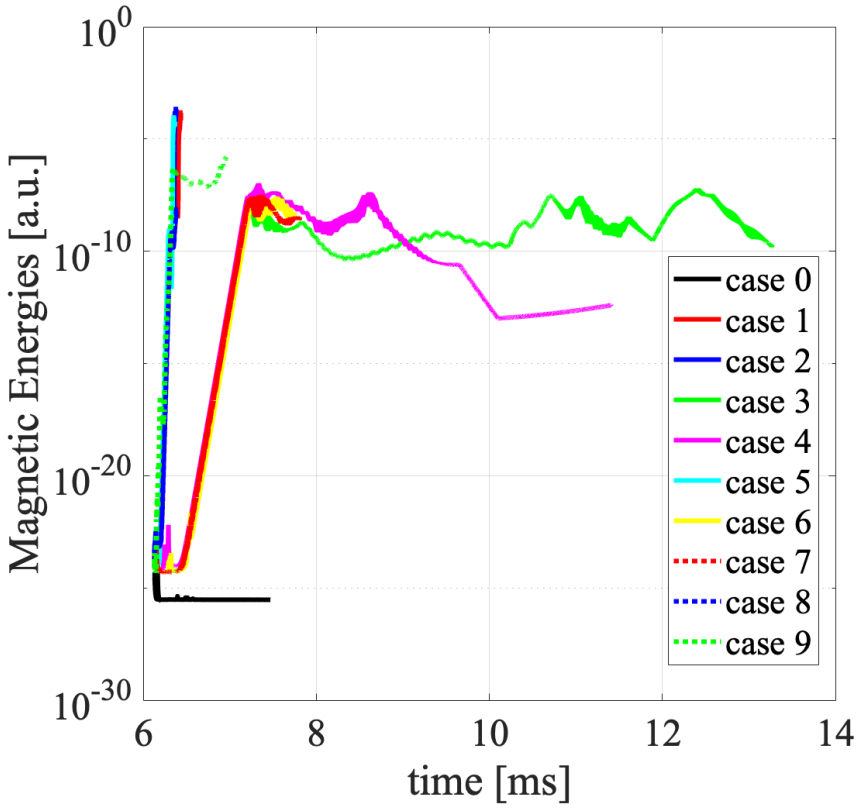




- Anyway, the pressure gradient increases in the pedestal region with the simulation including n=8 toroidal harmonic. → Good.
- My idea for next step to obtain ELM crash;
  - Shall I continue the case? → But difficult to continue due to numerical convergence.
  - Maybe the resistivity is too low to be unstable? Should I try other plasma parameters ?

Status 2022 (up to now)

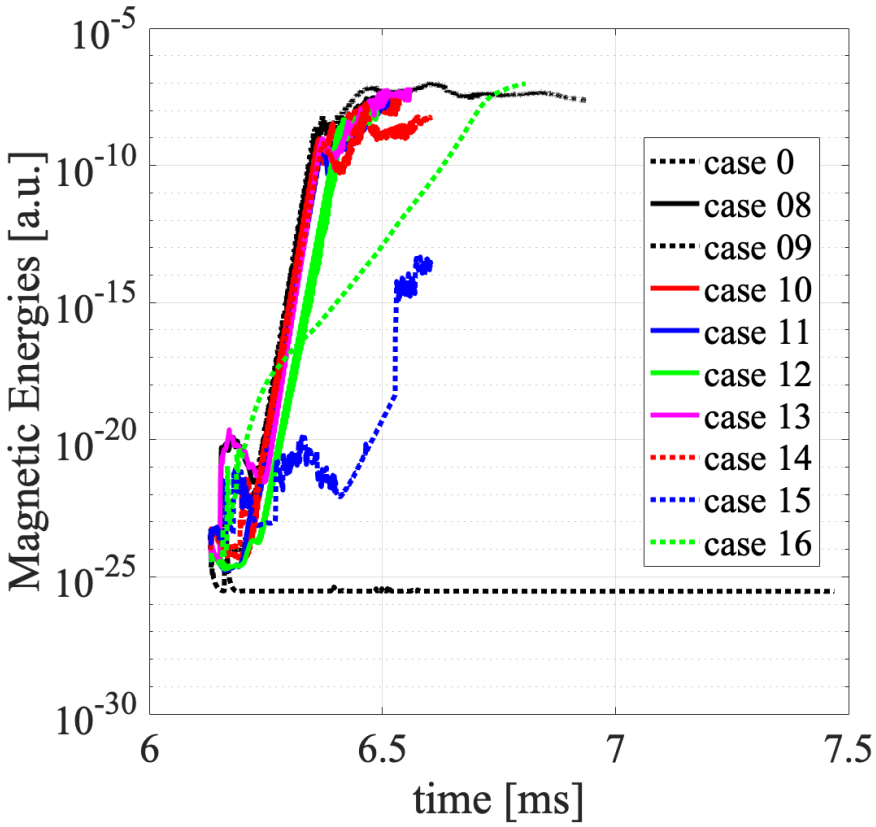
- Plasma parameters (resistivity, viscosity, particle and heat sources) are scanned.
- Scan of resistivity is shown below;
  - The increase of resistivity makes plasma unstable, but it shows too large growth rate than the time scale of pedestal build-up.



Literally, tens of simulations have been performed.
Only some cases are shown here.

Status 2022 (up to now)

- Plasma parameters (resistivity, viscosity, particle and heat sources) are scanned.
- Scan of particle/heat source is shown below;
  - The increase of source terms makes plasma unstable, but it does not reach the condition which plasma is unstable….



Literally, tens of simulations have been performed.
Only some cases are shown here.

Plan 2022

Status (Up to now)

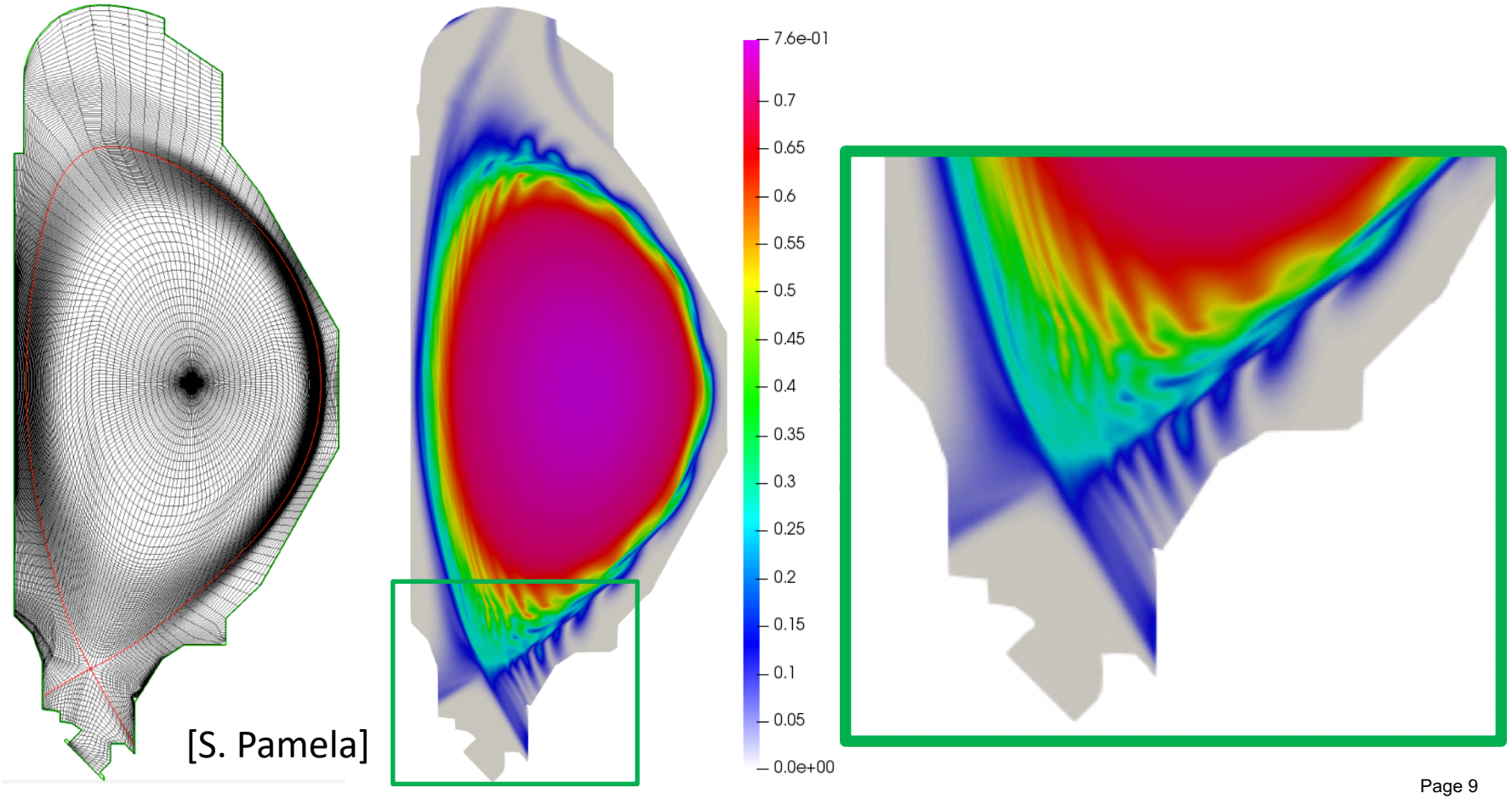
- **Self-consistent pedestal build-up is managed with the simulation including toroidal harmonics.**
- Scan of resistivity, viscosity, source amplitudes is being performed.
- In spite of my best effort, it is not yet managed to reproduce ELM crash. (すみません´Sumimasen` – see Appendix.)

Plan (rest of 2022)

- Continuation of the task; Preparation of simulation set-up for multi-ELM events
  - The analysis of diffusion profiles which sustain the pedestal shape.
  - Ask my colleague (A. Cathey etc.) to have advice.
- (When the natural ELM is managed,) launching pellets to study the plasma response.

Plan 2023

- (Assuming the multi-ELM simulation will be available) pellets simulations will be performed;
  - Study of lag-time and pellet condition to trigger an ELM.
  - Analysis of heat flux onto the divertor targets. (reconstruct the mesh is required.)



Appendix : Japanese language

How to say ‘Sorry’ or ‘excuse me’ (and ‘please’)

- In Japanese, there are several words to say sorry/excuse me, depending on the situation.
  - Sumimasen (すみません) : Easy expression, but also it can be super-serious as well. It can be used for ‘please’.
  - Gomennasai (ごめんなさい) : Probably, this is for specific situation, sounds serious but used for close friends in general. Only to apologize.

For example,

- **I’m sorry** for being late of my task. → Sumimasen (すみません)
- **Excuse me**, can you tell me …? → Sumimasen (すみません)
- (In a restaurant) **Please**, may I order …? → Sumimasen (すみません)

How to reply to somebody’s ‘Sorry’ or ‘excuse me’, or ‘please’

- Ie-ie (いえいえ) : This is casual way. “No worries’, ‘it’s nothing’. “You are welcome”
- Daijobu-desu (だいじょぶです) : This can be more polite. “No worries’, ‘it’s ok’.
- *No word/custom to reject somebody’s apologize (same to everywhere)..*